XVIII. *On the Urticating Properties of* Porthesia similis, *Fuess.* By Harry Eltringham, M.A., D.Sc., F.Z.S.

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Plate XXII.

In a former note * I pointed out that the urticating properties of the female of *P. similis* were due to the presence in the anal tuft, of barbed spicules, apparently identical in structure with those of the larva, and although it seemed probable that the moth derived its spicules from the cocoon, the manner in which it did so was not very obvious, since although there are many spicules in the cocoon the body of the moth would seem to be protected from contact, even during emergence, by the pupal skin.

During the past summer I have had an opportunity of studying the subject more fully, with extremely interesting results. I am indebted to Prof. Poulton for many useful suggestions, and to Commander Walker and Mr. A. H. Hamm for a portion of the material for my experiments.

The larva, though well known, seems not to have been examined very minutely, and it may be of interest to describe the structure in relation to the spicules, as revealed by a series of sections.

The spicules occur on every segment except the first and second. The third and fourth segments have two extra large masses which meet dorsally. On each remaining segment they occur on two dorsal and two dorso-lateral projections. Plate XXII, fig. 2, shows a diagrammatic section of half a segment, the spicule tufts being marked *S*.

The large hairs (*h*) arise from chitinous sockets which seem to occur all over the larva, though especially numerous on the lateral projections. These hairs are branched as shown in the figure. Amongst the dorso-lateral spicules are found white plume-like structures, one of which is shown at Plate XXII, fig. 2 (*p*). Occasionally these arise on the dorsal tufts also. To the unaided eye their matted branches

* Proc. Ent. Soc. Lond., p. lxxx, 1912.

have the appearance of white spots on the larva. Fig. 1 is a diagrammatic view of a section of the larval skin including one of these plumules. From this it is seen that the spicules *S*, are borne in tufts on small chitinous papillae, each of the latter being in direct communication with a double layer of special cells *E*. The spicules themselves are finely pointed barbed structures, the thicker outer end being triradiate. They are very easily detached; in fact, it is almost impossible to touch the larva without displacing them in considerable numbers. The plume-like structure * arises from a chitinous socket, differing little, if at all, from the sockets of the larger branched hairs, and having at its base several cells *G* apparently of a glandular nature. The plume is quite as easily detached as the spicules.

As in so many similar cases, it is much easier to determine the morphology than the physiology of these structures. The two layers of hypodermal cells *E* doubtless secrete the spicules themselves, but whether the gland *G* does more than merely secrete the plume, I am at present unable to decide. Neither the plumes nor the spicules have any appreciable action on litmus paper. During life the plume may serve to hold spicules, or even by itself becoming detached, to carry them to a distance. At least it seems improbable that so complicated a structure should have been evolved, merely as a factor in the rather conspicuous pattern of the larva.

The large branched hairs which occur all over the larva certainly serve to hold loose spicules, although this may be only a part of their function, and they are probably also mechanically protective.

The question whether the urticating properties of these and similar larvae are due to chemical or mechanical action or to both combined, still remains unsolved. Whilst I favour the purely mechanical theory I admit the difficulty of accounting for the marked difference of individual susceptibility to the urticating spicules of different species of larvae. In my own case the spicules of *Cnethocampa pityocampa* applied in small doses produce less irritation than those of *P. similis*, and yet the former species is generally regarded as the most "venomous" of all the

* This structure is proportionately a good deal longer than shown in the diagram.

European forms. Nor is there a great difference in the structure of the spicules, those of *C. pityocampa* being merely devoid of the triradiate barb at the thicker end.

The spicules of *C. pityocampa* have been variously said to contain formic acid, cantharidin, and no poison at all. Deegener, in the "Handbuch der Entomologie," seems to favour the theory of a combined chemical and mechanical action. I have found that the irritating effect of the spicules of this species is in no degree impaired by prolonged immersion in various solvents such as ether, alcohol, and xylol. On the sixth and seventh abdominal segments of the larva of *P. similis* there are two eversible glands which have been supposed to secrete a fluid which poisons the spicules. Of this there is no satisfactory evidence. The glands have probably a repugnatorial function. They have been described by Poulton (Trans. Ent. Soc. 1887, p. 300). The drop of moisture which often appears on these structures has no action on either red or blue litmus paper, nor indeed have I been able to detect any peculiar odour associated with them, though others seem to have noticed something of the kind.

To turn now to the imago. When full fed the larva spins a thin but tough cocoon, compounded of silk with which its own large hairs are interwoven. The inner lining of the cocoon is of much looser silk, and though spicules are scattered all through it there is a particularly dense mass of these arranged roughly in a belt round the inside of the lining, and placed towards the anterior end, a little beyond the middle, Fig. 3, *S*. The spicules adhere together in small masses probably owing to their barbed structure. By taking pupae out of their cocoons I was easily able to show that the moth obtains its spicules from the cocoon, since an imago hatched from a naked pupa never has any of these bodies in its anal tuft. I then carefully watched the emergence of imagines from naked pupae in order to see if there could be observed any appropriate movements which would result in the collection of the spicules. A male on emerging immediately crawled to the side of the box and assumed a position suitable for the expansion of its wings. The behaviour of a female was, however, quite different. Once out of the pupal skin it began a series of curious contortions of the abdomen. The latter was moved so that the anal tuft described a succession of circles, whilst by longitudinal expansion and contraction

of the segments the tuft was made to open and close, the action somewhat resembling the manner in which an elephant picks up small objects with its trunk. Not every female emerging from a naked pupa made these movements, or at least not for any appreciable length of time, a fact which suggested a further experiment which I shall describe later. I now wished to see the process actually carried on in the cocoon. Since it was not possible to decide when a moth was about to emerge from a pupa when the latter was enclosed, pupae were removed by cutting off the posterior end of the cocoon. With a little practice it is possible to determine with some accuracy by the appearance of the pupa when a moth is ready to emerge. As soon as it had cracked the pupal skin it was slipped back into the cocoon the open end of which was pinned down. From a male pupa so treated the moth emerged very rapidly. The anterior end of the cocoon seems to be comparatively thin, and a thrusting movement of the head and thorax soon tore a hole through which the moth emerged and ran to the side of the box. A female treated in the same manner at first emerged only so far as the anterior part of the thorax. In this position the extremity of her abdomen was just on a level with the band of spicules in the cocoon and she proceeded to carry out the peculiar movements I have already described. The anal tuft could be distinctly seen moving round and round the cocoon and opening and shutting amongst the spicules.

It is of great interest to note that the hairs of which the female tuft is composed are specially adapted to hold these spicules when collected, since towards their proximal ends they are irregularly spinose. Fig. 4 shows the ends of a few of these hairs with one or two spicules adhering thereto.

I have already said that not every female emerging from a naked pupa made the appropriate sweeping movements, a fact which suggested that normally the stimulus of contact with the cocoon was necessary. I therefore placed such a female after complete emergence but before the wings had begun to expand, in a cocoon. Almost immediately she began to make her way out and having partially emerged proceeded to sweep up the spicules in the manner already described.

One further point remains to be elucidated. Prof.